3D Photocatalytic Air Processor for Dramatic Reduction of Life Support Mass & Complexity

Completed Technology Project (2014 - 2015)

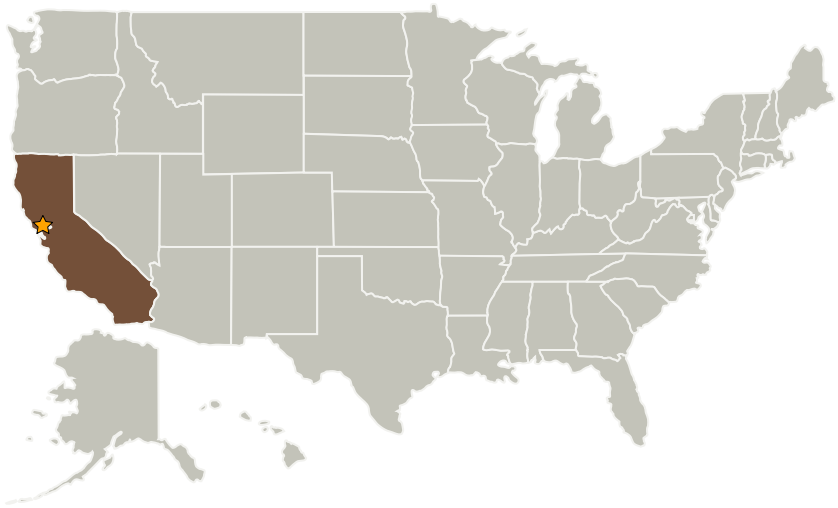
Project Introduction

The combination of novel photoelectrochemistry and 3-dimensional design allows tremendous mass saving, hardware complexity reduction, increases in deployment flexibility and removal efficiency. The high tortousity photocatalystic air processor design will achieve at least two orders of magnitude mass and power saving respectively, and enable feasibility of compact processors for spacecraft. The proposed work will demonstrate these drastic reduction in reactor mass, volume and power consumption in comparison to current technology with delivery of high-tortuosity device components allowed by 3D printing (potentially in space) at the end of the proposed work.

Anticipated Benefits

This technology has the potential to dramatically reduce the cost and risk of CO2 management systems in future extended missions. The High Tortuosity PhotoElectroChemical (HTPEC) system operates in much the same way a tree would function, namely directly contacting the cabin air with a photocatalyst in the presence of light and water (as humidity) to immediately conduct the process of CO2 reduction to O2 and useful, tunable carbon products. This eliminates many of the inefficiencies associated with current ISS CO2 management systems.

Primary U.S. Work Locations and Key Partners



Potential beneficiaries of the development of this concept

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Organizations Performing Work	Role	Type	Location
★Ames Research Center(ARC)	Lead Organization	NASA Center	Moffett Field, California

Primary U.S. Work Locations
California

Project Transitions

July 2014: Project Start

June 2015: Closed out

Closeout Summary: We have demonstrated in the Phase I studies the producti on, tunability and robustness of the novel composite catalysts following the preli minary work in the Chen laboratory. Additionally, we have designed, fabricated and tested all components of HTPEC device with active materials, including flow modeling to optimize flow mixing and pressure drop as well as the production of ethylene and other larger hydrocarbons. To best determine how this technology could be implemented, we also performed system integration optimization and t rade studies. This includes parameters such as mass, volume, power in relation to selected mission configurations, CO2 delivery methods and light source/delive ry approaches. The project schedule was initially delayed due to initial issues wit h processing of procurement funding at Ames. But with increased team efforts, we have accomplished every aspect of proposed phase I feasibility studies, and attracted collaboration from academics as well as industrial collaborators. The NI AC work has also received NASA Ames center management support with matchi ng funds and has been managed by NASA Ames Chief Technologist Office.

Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Center / Facility:

Ames Research Center (ARC)

Responsible Program:

NASA Innovative Advanced Concepts

Project Management

Program Director:

Jason E Derleth

Program Manager:

Eric A Eberly

Principal Investigator:

Bin Chen

Co-Investigators:

John E Hogan
Kenneth C Cheung
Darrell L Jan

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Images

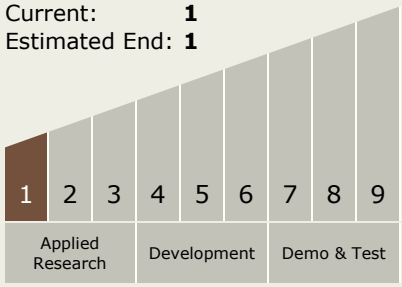
Humans on ISS
Potential beneficiaries of the development of this concept *(https://techport.nasa.gov/image/102161)*

Project Website:

https://www.nasa.gov/directorates/spacetech/home/index.html

Technology Maturity (TRL)

Start: **1**
Current: **1**
Estimated End: **1**



Technology Areas

Primary:

- TX02 Flight Computing and Avionics
  - TX02.1 Avionics Component Technologies
    - TX02.1.6 Radiation Hardened ASIC Technologies

Target Destination

Mars